

## Rock-Fall Hazards

William F. Case, Utah Geological Survey

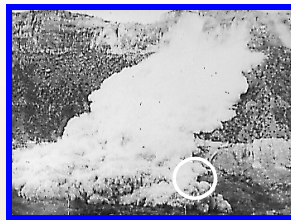
Rock falls are a natural process of cliff and hillside erosion. They consist of large rock fragments from a cliff, or boulders from a slope that bounce, roll, and slide down a hillside and come to rest in a "runout" zone at or near its base.

Many different processes cause rocks to become unstable and fall including gradual weathering and erosion, tree-root growth, and weakening of supporting rock by saturation from ground water. Excavation for a road cut or building may weaken bedrock support. Rock falls are commonly triggered by earthquake ground shaking, rapid snowmelt, wide diurnal temperature changes, and intense storms.

Although many rock falls occur in Utah each year, few are recorded or cause damage. However, from a history of 50 rock falls between December 10, 1887 and October 10, 1999, we can make the following observations.

- >> All Utah earthquakes of magnitude 5 or greater (nine total) triggered rock falls.
- >> Of the 39 rock falls that were not triggered by an earthquake and the month of occurrence is known, most occurred during the spring (11) and summer (12) months. Presumably this is because of spring thaw, summer cloudbursts, and diurnal temperature changes. July and March had the highest (10) and second-highest (5) occurrences respectively, per month.
- >> Personal injuries from rock falls and slides were rare. However, four people were killed and 11 people were injured, two seriously, in 50 events.
- >> Five rock falls damaged homes, 21 impacted highways, three damaged railroad tracks, and two breached water conduits.

### Castle Valley Rock Fall



Ron Drake, Moab Times-Independent.



At approximately 7 a.m. on July 8, 1985, 48,000 cubic yards of rock fell from Porcupine Rim, Grand County, barely missing an unoccupied house (circled) in the

community of Castle Valley. Dust entered open windows and covered the interior to a depth of an inch. The largest rock fall boulder in the runout zone was 50 X 15 X 15 feet. The triggering mechanism for the rock fall is unknown; it may have occurred when the night-cold, east-facing cliff was



warmed by the intense morning sun. Other recent rock falls show as light-colored scars elsewhere on the face of Porcupine Rim and as relatively vegetation-free, light-colored rock-pile slopes (talus) below the scars. Geologically older rock-fall scars and their deposits are darker and have more vegetation relative to the amount of time since the event. The scar at the "big bite" was produced by a rock fall witnessed in October 1978. Buildings constructed below the rim in the runout zone are in harm's way.



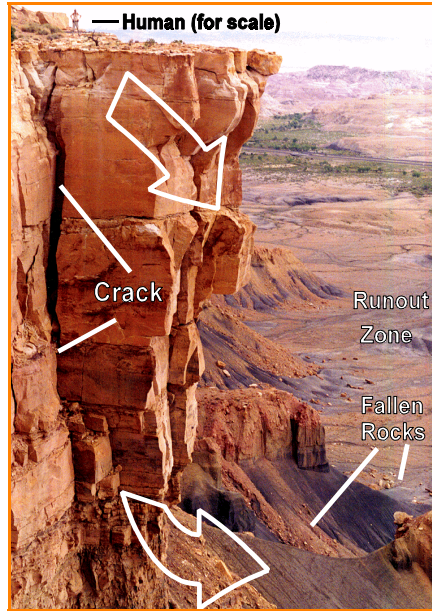


Homes (circled) in rock-fall runout zone, Bloomington, Washington County

Rock falls and slides are a threat to property and life within the runout zone. The runout zone extends from the slope below the source downward to at least the maximum distance from the cliff that rocks have fallen and rolled.

Utility and transportation corridors like power lines, pipelines, tracks, and highways are damaged by rock falls more often than buildings because they commonly extend along the base of slopes.

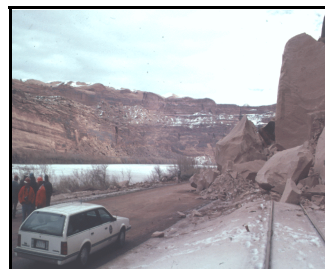
The Dead Horse Point State Park rock fall in 1984 was recorded on seismographs up to 30 miles away. Seismographs recorded events up to a magnitude 2.5 due to large rock falls in Yosemite National Park; the falls produced an airblast that toppled trees and stripped branches. Rock-fall witnesses often



Future rock fall, and runout zone of past rock falls, Emery County. Michael D. Laine.

report the sound of a sonic boom.

Rock-fall damage to Olmstead Aqueduct, Provo River Canyon, Utah County. Robert Robison.



Rock fall on Potash Road (SR 279), D&RG rail tracks, and the Colorado River, Grand County. Craig Morgan, UGS.

## Rock-Fall Risk Reduction

In addition to avoiding the runout zone, rock-fall risk is reduced by (1) preventing rocks from falling, (2) removing them, or (3) providing protection when they fall.

Rock bolts, buttresses, wire mesh, or shotcrete (concrete sprayed on a road cut) will help prevent rocks from falling.

Good drainage will relieve pressure on rocks perched on a slope and reduce weathering and erosion.



Chain-link fence protection.



Ditch, berm, and chain-link fence for rock-fall protection, Bluff Street, St. George.

Chain-link fences offer protection from local, small rocks. Gabions or Jersey barriers also provide protection from rolling rocks.

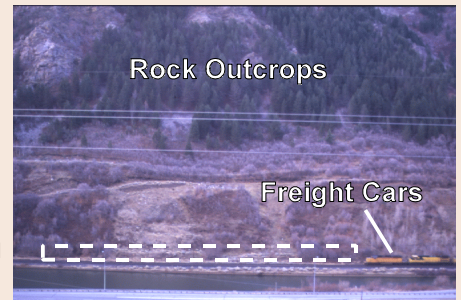
Rolling boulders can be trapped in a ditch with a berm to prevent them from bouncing out.

Railroad tracks can

be monitored for landslide, including rock-fall, damage with wire sensors that sound an alarm when they are hit.

Pipelines are often buried for protection from falling rock.

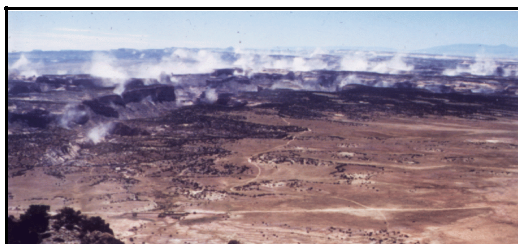
Roofs over highways and railroad tracks shield them from falling rock.



Alarm fence (dashed area) along railroad track, Weber Canyon, Weber County. Rich Giraud, UGS.

The Utah Geological Survey documents and evaluates geologic hazards such as rock falls to protect citizens of Utah. If you wish to report a rock fall or other landslide, or want more information, please contact the Utah Geological Survey at:

**Utah Geological Survey**, PO Box 146100, Salt Lake City, UT 84114-6100, phone 801-537-3300. The office is located at 1594 West North Temple, Salt Lake City. The web site is [www.ugs.state.ut.us](http://www.ugs.state.ut.us).



Dust produced by simultaneous rock falls triggered by a magnitude 5.3 earthquake in Emery County. Terry A. Humphrey, Bureau of Land Management.